# Psychological intervention for gambling disorder: A systematic review and meta-analysis

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**REVIEW ARTICLE**

## ABSTRACT

*Background and aims:* Increasingly, gambling features migrate into non-gambling platforms (e.g., online gaming) making gambling exposure and problems more likely. Therefore, exploring how to best treat gambling disorder (GD) remains important. Our aim was to review systematically and quantitatively synthesize the available evidence on psychological intervention for GD. *Methods:* Records were identified through searches for randomized controlled trials (RCTs) evaluating psychological intervention for GD via six academic databases without date restrictions until February 3, 2023. Study quality was assessed with the revised Cochrane risk-of-bias tool for randomized trials (RoB2). Primary outcomes were GD symptom severity and remission of GD, summarized as Hedges' $g$ and odds ratios, respectively. The study was preregistered in PROSPERO (#CRD42021284550). *Results:* Of 5,541 records, 29 RCTs (3,083 participants analyzed) were included for meta-analysis of the primary outcomes. The efficacy of psychological intervention across modality, format and mode of delivery corresponded to a medium effect on gambling severity ($g = -0.71$) and a small effect on remission (OR = 0.47). Generally, risk of bias was high, particularly amongst early face-to-face interventions studies. *Discussion and conclusions:* The results indicate that psychological intervention is efficacious in treating GD, with face-to-face delivered intervention producing the largest effects and with strongest evidence for cognitive behavioral therapy. Much remains to be known about the long-term effects, and investigating a broader range of treatment modalities and digital interventions is a priority if we are to improve clinical practice for this heterogeneous patient group.

## KEYWORDS

# INTRODUCTION

Gambling is a serious public health issue (Canale, Vieno, & Griffiths, 2016; John et al., 2020), and in Western populations 0.4–2.0% develop gambling disorder (GD) (Chóliz, Marcos, & Lázaro-Mateo, 2019; Delfabbro & King, 2012; Erbas & Buchner, 2012; Kessler et al., 2008; Stefanovics & Potenza, 2022). Commonly referred to as a behavioral addiction (Yau & Potenza, 2015), GD is characterized by recurrent maladaptive patterns of gambling and related harmful behaviors

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(American Psychiatric Association, 2013). Individuals suffering from GD experience a number of negative consequences, such as massive debt, increased risk of developing mood and anxiety disorders, and suicide, affecting their social and professional relationships in extension (Moghaddam, Campos, Myo, Reid, & Fong, 2014; Moghaddam, Yoon, Dickerson, Kim, & Westermeyer, 2015; Petry, Stinson, & Grant, 2005). As a consequence, a number of countries have initiated gambling-related legislation and a provision of a wide range of preventive measures and treatment services (Adam & Raschzok, 2014; Jensen, 2017). GD patients often suffer from one or more comorbidities (e.g., ADHD, personality disorder, substance use disorders) (Dowling, Merkouris, & Lorains, 2016) and research strongly suggests that patients may be differentiated into at a number of subtypes (Excell et al., 2022) for instance according to etiological factors and their motives for gambling (Nower, Blaszczynski, & Anthony, 2021). Thus, GD patients are very heterogeneous, potentially complicating treatment. Although the use of medication is steadily receiving attention in research, still no pharmacotherapy has a formal indication for GD (Kraus, Etuk, & Potenza, 2020), and psychological intervention remains the common approach to treating GD (Potenza et al., 2019). Several psychological interventions using different therapeutic approaches, formats, and modes of delivery are available. In research, the most commonly assessed therapeutic modalities include Cognitive Behavioral Therapy (CBT) and Motivational Interventions (MI) such as Motivational Interviewing and Motivational Enhancement Therapy (Cowlishaw et al., 2012; Goslar, Leibetseder, Muench, Hofmann, & Laireiter, 2017). Traditionally, face-to-face therapy has been offered in both individual and group formats. During the last two decades, researchers have examined alternative modes of delivery, including telephone counselling (Abbott et al., 2017), self-help books (Oei, Raylu, & Lai, 2017), and digital intervention programs with or without therapist guidance through phone, email, or text messages (Dowling et al., 2021; Jonas et al., 2020; McAfee, Martens, Herring, Takamatsu, & Foss, 2020). This trend of rethinking and digitalizing modes of delivery within psychological intervention for GD occurs along with rapid developments and digitalization of gambling products within and outside governmental regulatory frameworks. Increasingly, gambling resembling features are migrating into non-gambling platforms (e.g., loot boxes in online gaming), and virtual properties and cryptocurrencies are highly utilized as stakes for gambling. Consequently, gambling exposure is more likely than ever potentially leading to an increased incidence of gambling problems and thus GD, especially among young people (Rambøll, 2022). Therefore, gathering and conveying up-to-date knowledge on GD treatment is of crucial importance.

Previous systematic reviews and meta-analyses have examined the efficacy of different subtypes of psychological interventions for GD (Quilty, Wardell, Thiruchselvam, Keough, & Hendershot, 2019; Sagoe et al., 2021; Yakovenko, Quigley, Hemmelgarn, Hodgins, & Ronksley, 2015). All suggest that psychological interventions may have positive effect on GD severity, whether they are brief or extended or whether they are delivered face-to-face or remotely.

However, since the most recent broad-scope meta-analysis (Goslar et al., 2017), several RCTs have been published, and there is a need to investigate the efficacy of psychological interventions across the currently available modalities (e.g., CBT, MI, mindfulness-based CBT), modes of delivery (face-to-face, remote) and formats (individual, group). Furthermore, to maximize the quality of the evidence, there is a need to focus on RCTs exclusively. On this background we conducted a systematic review and meta-analysis exploring the overall efficacy of psychological intervention for GD and compared efficacy across modalities, modes of delivery, and formats.

## METHODS

This systematic review and meta-analysis was done in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021) (see checklist with item locations, Supplementary Material 2), and preregistered with PROSPERO (ID: CRD42021284550). The decision to add meta-analysis to our systematic review was made after the original registration, leading to minor changes related to extension of the review team, secondary outcomes, and the population of interest. Readers are referred to the meta-analysis protocol (attached to the PROSPERO registration or available upon request) for full descriptions of these changes.

### Search strategy

First searches were conducted in the electronic databases of the Cochrane Central Register of Controlled Trials, PubMed, PsycInfo, Web of Science, Scopus, and Embase for articles investigating the efficacy of psychological interventions on GD from database inception to October 12, 2021. The search strings combined terms related to gambling and disorder (i.e., "gambl*" AND "disord*", "patholog*"), psychological intervention (i.e., "intervent*", "therap*", and "treat*") and RCTs (i.e., "RCT", "random*", and "control*"). MeSH and Emtree terms were incorporated when applicable (See Supplementary Material 1 Table S1 for details of search strategy). Backward snowballing was conducted using the reference lists of previously published systematic reviews and meta-analyses (Cowlishaw et al., 2012; Gooding & Tarrier, 2009; Goslar et al., 2017; Marchica & Derevensky, 2016; Maynard, Wilson, Labuzienski, & Whiting, 2018; Peter et al., 2019; Petry, Ginley, & Rash, 2017; Quilty et al., 2019; Ribeiro, Afonso, & Morgado, 2021; Sagoe et al., 2021; Smith, Dunn, Harvey, Battersby, & Pols, 2013; Yakovenko et al., 2015), and of all studies included for synthesis. On included studies a citation search was conducted in the Web of Science and Scopus databases. We conducted two additional database searches on July 8, 2022 post data-extraction, and on February 3, 2023 prior to manuscript submission, using our predefined search strings, to ensure identification of recently published RCTs.

## Selection criteria

Eligible studies were reported in peer-reviewed publications written in English, covering RCTs investigating adults (≥18 years) with GD according to cut-offs on validated screening tools or clinical diagnostic interviews, employing at least one psychological intervention and including at least one passive or active control group, while providing data on the primary outcomes (description below). RCTs were excluded if no full-text report was available, if the sample consisted of participants with sub-clinical levels of gambling problems or patients with severe neurological or psychiatric disorders (e.g., Parkinson's disease, psychotic disorders, severe depression); if the intervention was not targeting the GD patient (e.g., interventions for spouses); and/or if interventions included pharmacotherapy. Two authors (JE and AF) independently screened the titles and abstracts of the studies and subsequently selected full texts. Disagreements were resolved by negotiation or by a third reviewer (MWP).

## Primary and secondary outcome variables

Primary outcomes were 1) GD symptom severity (gambling severity) based on DSM-III/IV/5 criteria and/or validated instruments with or without clinical cut-offs, and 2) remission based on clinician-administered diagnostic interviews and/or self-report screening tools with verified clinical Cut-offs. In addition, we explored the effects of psychological interventions for GD on the secondary outcomes of depressive symptoms and anxiety. The secondary outcomes were included when based on validated instruments with or without clinical cut-offs. As part of the study protocol we planned to extract data on the patients' level of social functioning before and after intervention, since GD is associated with both relational and occupational dysregulation, but only one study (Lee & Awosoga, 2015) reported data on this variable, hence social functioning was excluded from the analysis. As a possible mechanism of change, we also intended to explore any associations between cognitive distortions and treatment efficacy, but too few data were available for this analysis to occur.

## Quality of studies and of evidence

Study quality was assessed independently by two authors (JWE and AF) using the revised Cochrane risk-of-bias assessment tool for randomized trials (RoB2) (Sterne et al., 2019), resulting in overall risk of bias estimates of high, some concerns, or low. These overall ratings were dependent on ratings across the five domains of randomization, deviation from intervention, missing outcome, measurement of the outcome, and selective reporting. Disagreements were resolved through negotiation between raters and a third researcher (MWP). In order to ensure a consistent evaluation of the confidence in our pooled estimates, two authors (JWE and MWP) rated and negotiated the quality of evidence of the meta-analytic results (high, moderate, low, and very low) using the online tool accompanying the

Grading of Recommendations Assessment, Development and Evaluation (GRADE) system (Guyatt, Oxman, Schünemann, Tugwell, & Knottnerus, 2011). This system takes into account several variables linked to certainty of the evidence such as study design, risk of bias, as well as inconsistency, indirectness, and imprecision of results. Besides psychological intervention overall, we evaluated the quality of evidence of the effect estimates obtained for face-to-face intervention, for remote intervention, and for CBT as separate categories, all covered by several studies in our sample.

## Data extraction and coding

Using a prepared template, data were extracted from published reports and coded at the study level by two authors independently (JWE and MWP). Discrepancies were identified and resolved in collaboration. For each study, the number of patients (N), means and standard deviations (SD) for primary and secondary outcomes on any assessment points (baseline, post-intervention, and follow-up) were retrieved. If these data were unavailable and could not be obtained from study authors, we screened reports for other data to be used in estimating an effect size (e.g., F-values, $t$-values, regression coefficients, correlations, or $p$-values).

To determine eligibility for the main analyses and to enable investigation of possible sources of heterogeneity, all reports were examined for information on predefined variables, including study eligibility criteria, intervention modality (CBT, MI, contemporary CBT, other interventions), mode of delivery (face-to-face, remote), format (group, individual), therapist guidance (yes, no), number of therapist sessions, duration of treatment, type of control group (passive, active), patient characteristics (e.g., mean age, proportion with GD, proportion female), therapist fidelity assessment, and study risk of bias.

## Data analysis

All primary and secondary outcomes were calculated as between-group comparisons at post-intervention and follow-up if available. Odds ratios (ORs) were calculated for binary outcomes, and standardized mean differences (Hedges' g, adjusted for small sample bias) were calculated for continuous outcomes (Hedges & Olkin, 1985). ORs smaller than 1.0 and negative values of g indicated a treatment effect in favor of the intervention compared with control. All pooled estimates were complemented by 95% confidence intervals (CI) and 95% prediction intervals (PI (i.e., the interval in which 95% of future observations will fall, given the observed data)) (IntHout, Ioannidis, Rovers, & Goeman, 2016). In addition, the number-needed-to-treat (NNT) was calculated for primary outcomes (Kraemer & Kupfer, 2006) in order to provide a more easily comprehensible measure of treatment effect.

Pooled estimates were calculated when data from three or more studies were available. If studies reported data on

multiple instruments for the same outcome, an average effect size across instruments was calculated to ensure that each study sample was only represented once in each analysis. If studies included more than one intervention and/or control group, we calculated the average effect across possible comparisons. If a study group contributed to more than one comparison (e.g., in moderator analysis, a three-armed RCT covering two treatment modalities), the group size was divided accordingly (Higgins et al., 2019; Puhan, Soesilo, Guyatt, & Schünemann, 2006).

To test the robustness of pooled estimates, sensitivity analyses were conducted by removing outliers. Outliers were defined as studies with effect estimates two standard deviations above or below the pooled estimate. Additionally, to investigate whether our decision to include personalized feedback interventions (PFI) as active control conditions influenced results, pooled estimates in which PFI conditions were removed from the analyses were calculated. PFIs were coded as active control conditions rather than treatment conditions due to their brief nature (10–15 min) and minimal therapeutic content.

## Heterogeneity and moderator analysis

Between-study heterogeneity was expected, and a random effects model was used in all analyses. Heterogeneity of effect sizes was assessed with $I^2$, Cochrane's Q, Tau, $Tau^2$, and PI (Borenstein, Hedges, Higgins, & Rothstein, 2010; Higgins, Thompson, Deeks, & Altman, 2003). When the results indicated heterogeneity, subgroup and meta-regression-based moderator analyses were employed to explore possible sources. Subgroup analysis was employed when data were available for three or more studies. Meta-regression-based moderator analyses were conducted when data from 10 or more studies were available. Publication bias was evaluated with funnel plots, and if the results were suggestive of publication bias, the pooled effect size was adjusted using the trim-and-fill method (Duval & Tweedie, 2000). Due to the limited number of studies and significant heterogeneity, Egger's test was not employed (Ioannidis & Trikalinos, 2007). STATA version 17.0 was used for all analyses.

## RESULTS

## Study selection

The systematic literature search yielded 12,945 hits across the six databases. After screening and study selection, 34 RCTs were initially included in the systematic review (PRISMA flow diagram, Fig. 1) The two authors (JWE, AF) who had independently screened the literature disagreed on three studies, which were included after negotiation with a third author (MWP). For five of 34 studies (Carlbring, Jonsson, Josephson, & Forsberg, 2010; Cunningham, Hodgins, Toneatto, Rai, & Cordingley, 2009; Dowling, Smith, & Thomas, 2007; Hodgins, Currie, &

El-Guebaly, 2001; Yakovenko & Hodgins, 2021), we were unable to obtain sufficient data on the primary outcomes. One of these studies provided data on our secondary outcomes (Dowling et al., 2007). Therefore, 29 studies were included in the meta-analysis of primary outcomes, and a total of 30 studies were included across all outcomes. Table 1 provides an overview of the 30 studies included in the meta-analysis. For general characteristics of all 34 studies initially identified, see Supplementary Material 1 Table S2.

## Study characteristics

Across studies, a total of 4,848 individuals were randomized (2,608 to intervention groups), and 3,139 were analyzed. Sample mean ages ranged from 20 to 52 years, and approximately 40% of patients were female. In 16 studies, GD was an inclusion criterion, and across all studies approximately 85% of individuals displayed symptoms equivalent to GD at baseline. Studies were published between 1997 and 2021. Twenty-five groups received CBT, four groups received MI, and eight groups received CBT in combination with MI. Few studies investigated the efficacy of other modalities (Table 1) and were incorporated in the analysis as one category (other). Twenty-five groups received face-to-face intervention, individually ($n = 15$) or in groups ($n = 10$). Eighteen groups received remote intervention with ($n = 9$) or without therapist guidance ($n = 9$). Of the 34 control groups, 23 were passive (waitlist, assessment only), and 11 were active (attention control, treatment as usual, personalized feedback intervention (PFI)). The intended number of therapist sessions (for treatment or support) ranged from zero (unguided remote intervention) to 20. Treatment periods varied between four and 24 weeks. Twenty-nine, 13, eight, and seven studies provided data on gambling severity, remission, depressive symptoms, and anxiety, respectively.

## Overall efficacy

Overall psychological intervention was associated with reduction in gambling severity ($g = -0.71$ [95% CI -1.03–-0.39], $p < 0.001$), and enhanced remission (OR = 0.47 [0.26–0.88], $p = 0.0178$) equaling an NNT of 2.6 and 5.3 respectively. No publication bias was detected. For both estimates $I^2$ revealed high heterogeneity. Removing two outliers ($g = 2$ SD $\pm$ pooled average) from the estimate of gambling severity negatively impacted the effect size ($g = -0.59$). Pooled estimates are presented in Table 2, and Fig. 2 displays the forest plot of the overall pooled effect size from the gambling severity outcome.

## Modality, format, and mode of delivery

Among modalities, CBT was associated with the largest reduction in gambling severity ($g = -0.85$), and was the only modality covered sufficiently ($K > 3$) for a remission estimate (OR = 0.45). Regarding the outcome of gambling severity, CBT was closely followed by the "other"-category
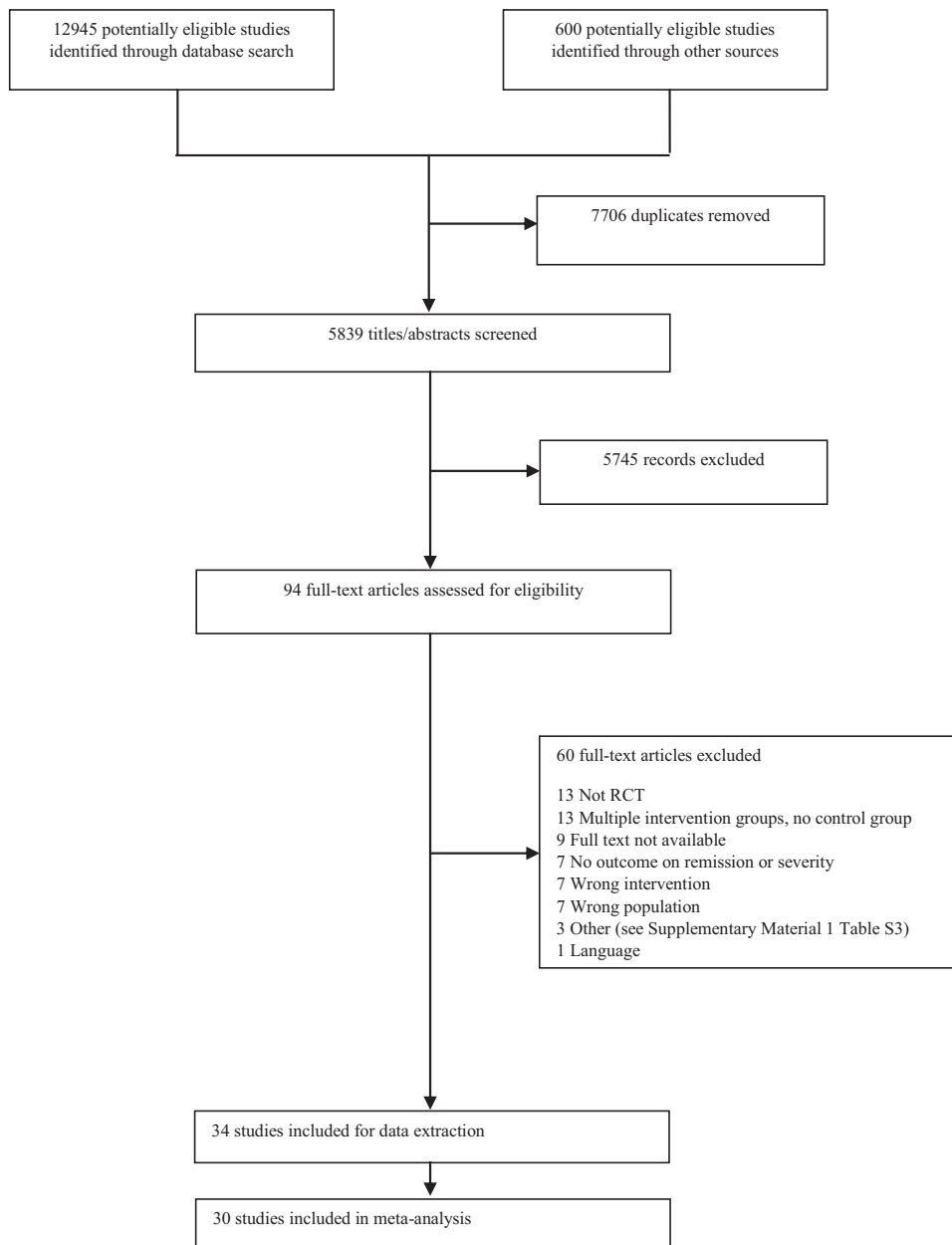
*Fig. 1.* Study selection

Database search was conducted at October 12, 2021 and again on July 8, 2022 and February 3, 2023 to ensure that recently published records would be identified. See Supplemetary Material 1 Tabel S1 for more information

associated with a medium-large effect size ($g = -0.78$). MI was the only modality that was not associated with significant effects on primary outcomes.

Overall face-to-face delivered intervention was associated with reduction in gambling severity ($g = -1.03$) and increased remission (OR = 0.24). Both individual therapy ($g = -0.89$, OR = 0.54) and group-based intervention ($g = -1.33$, OR = 0.10) were associated with reductions in gambling severity and increased remission, although the results for remission was not significant for individual therapy.

When pooling the 13 studies of remotely delivered intervention, we found a significant reduction in gambling severity ($g = -0.36$). Numerically, the results for remission were slightly in favor of intervention, but not significantly ($p = 0.3850$). In this category, we further explored the efficacy of therapist-guided and unguided interventions separately together with internet based-intervention as a separate category. Although generally in favor of intervention groups, no results were significant (Table 2).

Where possible, the potential influence of delivery mode and formats were explored within each treatment modality.
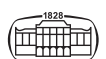
*Table 1.* General information on studies included in the meta-analysis

| Author *year* | Country | N[a] | N[b] | % w. GD | % female | mean age | Intervention groups | Control groups | Primary outcomes | Secondary outcomes | Pre-Post (weeks) | FU[c] (months) | RoB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sylvain et al. (1997) | Canada | 40 | 29 | 100 | 0.0 | 40.2 | 1) CBT face-to-face, individually | 1) WL | DSM-III SOGS | – | – | 6 12 | High |
| Ladouceur et al. (2001) | Canada | 88 | 64 | 100 | 19.3 | 41.7 | 1) CBT face-to-face, individually | 1) WL | DSM-IV SOGS | – | 12 | 6 12 | High |
| Ladouceur et al. (2003) | Canada | 71 | 59 | 100 | 22.0 | 43.3 | 1) CBT face-to-face, group | 1) WL | DSM-IV | – | 16 | 6 12 24 | High |
| Melville et al. (2004) (1) | USA | 13 | 13 | 100 | 61.5 | – | 1) CBT face-to-face, group 2) CBT (extended) face-to-face, group | 1) WL | DSM-IV | – | 8 | 8 | High |
| Melville et al. (2004) (2) | USA | 19 | 19 | 100 | 84.2 | – | 1) CBT face-to-face, group | 1) WL | DSM-IV | BAI BDI-II | 8 | 8 | High |
| Petry et al. (2006) | USA | 231 | 231 | 100 | 45.0 | 44.9 | 1) CBT self-help, no therapist guidance (GA referral) 2) CBT face-to-face, individually (GA referral) | 1) AO (GA referral) | SOGS DSM-IV ASI-G | – | 8 | 6 12 | High |
| Dowling et al. (2007)* | Australia | 56 | 56 | 100 | 100 | 43.6 | 1) CBT face-to-face, individually 2) CBT face-to-face, group | 1) WL | DSM-IV | STAI-T STAI-S BDI-II | 12 | 6 | High |
| Carlbring and Smit (2008) | Sweden | 66 | 66 | 100 | 6.0 | 31.9 | 1) MI/CBT self-help, no therapist guidance | 1) WL | NODS | HADS-A HADS-D | 12 | 6 18 36 | High |
| Korman et al. (2008) | Canada | 42 | 42 | 100 | 14.3 | 47.6 | 1) DBT face-to-face, individually | 1) TAU | PGSI | – | 14 | 6.5 | SC |
| Petry, Weinstock, Ledgerwood, and Morasco (2008) | USA | 180 | 172 | 52.8 | 40.0 | 43.5 | 1) MI face-to-face, individually 2) MI/CBT face-to-face, individually | 1) AO 2) PFI | SOGS ASI-G | – | 6 | 9 | High |
| Grant et al. (2009) | USA | 68 | 68 | 100 | 38.2 | 48.7 | 1) CBT/MI face-to-face, individually | 1) GA referral | PG-YBOCS G-SAS | HAM-A HAM-D | 8 | 6 | High |
| Myrseth, Litlere, Støylen, and Pallesen (2009) | Norway | 14 | 14 | 100 | 21.4 | 37.4 | 1) CBT face-to-face, individually | 1) WL | DSM-IV | BAI MADRS | 7 | 4.75 | High |
| Petry, Weinstock, Morasco, and Ledgerwood (2009) | USA | 117 | 114 | – | 15.4 | 20.4 | 1) MI face-to-face, individually 2) MI/CBT face-to-face, individually | 1) AO 2) PFI | SOGS | – | 6 | 9 | High |

*(continued)*

*Table 1.* Continued

| Author *year* | Country | N[a] | N[b] | % w. GD | % female | mean age | Intervention groups | Control groups | Primary outcomes | Secondary outcomes | Pre-Post (weeks) | FU[c] (months) | RoB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Larimer et al. (2011)* | USA | 147 | 111 | 10.2 | 34.7 | 21.2 | 1) MI face-to-face, individually 2) CBT face-to-face, group | 1) AO | NODS | BACS | 24 | – | High |
| Marceaux and Melville (2011) | USA | 49 | 33 | 100 | 65.3 | 47.8 | 1) 12-step (TSF) face-to-face, group 2) CBT face-to-face, group | 1) WL | DSM-IV SOGS | BAI BDI-II | 8 | 6 | High |
| Lee and Awosoga (2015) | Canada | 18 | 16 | 100 | 34.0 | 49.3 | 1) CCT face-to-face, couple | 1) AO | G-SAS | DAS | 12 | 5 | High |
| Wong, Chung, Wu, Tang, and Lau (2015) | China | 40 | 31 | 83.9 | 0.0 | – | 1) CBT face-to-face, group | 1) AO | SOGS | GRCS DASS-21 A DASS-21 D | 10 | – | High |
| Luquiens et al. (2016) | France | 1,122 | 144 | 8.0 | 7.9 | 34.7 | 1) CBT self-help, no therapist guidance 2) CBT self-help, therapist guidance | 1) WL | PGSI | – | 6 | 3 | High |
| McIntosh et al. (2016) | Australia | 77 | 77 | 98.7 | 28.6 | 38.5 | 1) CBT (and MBCT) face-to-face, individually 2) CBT (and MBCT) face-to-face, individually | 1) TAU | DSM-5 SOGS | – | 13 | 6.25 9.25 | High |
| Petry et al. (2016) | USA | 217 | 217 | 86.2 | 31.3 | 42.0 | 1) MI/CBT face-to-face, individually | 1) WL, AC 2) PFI | SOGS | – | 8 | 5 8 12 16 20 24 | High |
| Abbott et al. (2017) | New Zealand | 462 | 346 | 95.0 | 52.6 | 39.2 | 1) MI phone 2) MI phone + CBT self-help 3) MI phone + CBT self-help/phone | 1) TAU | PGSI | – | 12 | 6 12 36 | Low |
| Boudreault et al. (2017) | Canada | 62 | 54 | 82.3 | 38.7 | 51.5 | 1) MI phone + CBT self-help | 1) WL, AC | DSM-5 | BAI BDI-II | 11 | 3.75 8.75 14.75 | High |
| Casey et al. (2017) | Australia | 174 | 174 | 100 | 59.2 | 44.4 | 1) CBT internet program, no therapist guidance 2) MFS internet program, therapist guidance | 1) WL | SOGS G-SAS | GRCS DASS-21 A DASS-21 D | 6 | – | High |

*(continued)*

*Table 1.* Continued

| Author *year* | Country | Nᵃ | Nᵇ | % w. GD | % female | mean age | Intervention groups | Control groups | Primary outcomes | Secondary outcomes | Pre-Post (weeks) | FUᶜ (months) | RoB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oei et al. (2017) | Australia | 110 | 55 | – | 50.9 | 49.4 | 1) CBT self-help, no therapist guidance | 1) WL | CPGI | GRCS DASS-21 A DASS-21 D | 6 | – | High |
| Cunningham, Godinho, and Hodgins (2019) | Canada/USA | 321 | 278 | 58.6 | 55.1 | 36.5 | 1) CBT internet program, no therapist guidance | 1) WL, AC | NODS G-SAS | – | 6 | 6 | SC |
| Hodgins, Cunningham, Murray, and Hagopian (2019) | Canada | 187 | 187 | 89.0 | 47.1 | 46.8 | 1) CBT internet program, no therapist guidance | 1) PFI | NODS PGSI | – | 12 | 6 12 | Low |
| Jonas et al. (2020) | Germany | 167 | 167 | 98.2 | 28.1 | 33.5 | 1) Solution focused/self-regulation/MI internet program, therapist guidance 2) Solution focused/self-regulation/MI, no therapist guidance | 1) WL | PGSI | – | 12 | 6 12 | High |
| McAfee et al. (2020) | USA | 255 | 255 | 15.3 | 38.0 | 22.2 | 1) PFI/CBT text messages | 1) AO 2) PFI | PGSI/CPGI | GRCS | 4 | 6 | High |
| So et al. (2020) | Japan | 254 | 185 | – | 20.8 | 36.3 | 1) CBT text messages | 1) AO | PGSI G-SAS | – | 4 | – | Low |
| Bücker, Gehlenborg, Moritz, and Westermann (2021) | Germany | 156 | 65 | 99.3 | 32.7 | 35.0 | 1) CBT (third wave elements) internet program, no therapist guidance (TAU allowed) | 1) WL (TAU allowed) | SOGS PG-YBOCS | GABS-15 PHQ-9 | 8 | – | SC |

*Abbreviations:* AO, assessment only; AC, attention control; ASI-G, Addiction Severity Index for Gambling; BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; BDI-II, Beck Depression Inventory II; CBT, cognitive behavioral therapy; CPGI, Canadian Problem Gambling Index; DAS, Dyadic Adjustment Scale; DASS-21, Depression, Anxiety and Stress Scale 21; DBT, dialectical behavior therapy; FU, Follow-up; GA, Gambler Anonymous; GAD-7, Generalized Anxiety Disorder Questionnaire 7; GD, Gambling Disorder; G-SAS, Gambling Symptom Assessment Scale; HADS-A, Hospital Anxiety and Depression Scale-Anxiety; HADS-D, Hospital Anxiety and Depression Scale-Depression; HAM-A, Hamilton Anxiety Rating Scale; HAM-D, Hamilton Depression Rating Scale; MADRS, Montgomery & Åsberg Depression Rating Scale; MFS, monitoring, feedback and support; MI, motivational intervention; NODS, NORC Diagnostic Screen for Gambling Problems; PFI, personalized feedback intervention; PGSI, Problem Gambling Severity Index; PG-YBOCS, Yale Brown Obsessive Compulsive Scale adapted for Pathological Gambling; PHQ-9, Patient Health Questionnaire 9; RAS-G, Relation Assessment Scale Generic; RoB, Risk of Bias assessment According to the revised Cochrane risk-of-bias assessment tool for randomized trials (RoB2)[39]; SC, some concerns; SOGS, South Oaks Gambling Screen; STAI-S, State-Trait Anxiety Inventory, State-anxiety; STAI-T, State-Trait Anxiety Inventory, Trait-anxiety; TAU, treatment as usual; TSF, Twelve-step Facilitated therapy; VGS, Victorian Gambling Screen; WL, waiting list; WSAS, Work and Social Adjustment Scale. a) Number of participants randomized, b) number of participants represented in our analysis on primary outcome *gambling severity* post intervention, c) In a majority of studies, follow-up data were only available for the intervention group, and no comparisons were possible, *not included in post-intervention estimate on primary outcomes.

*Table 2.* Pooled estimates for all comparisons, modality, mode of delivery and format across outcomes

| Outcome | K | Effect size [95% CI] | p | $I^{2*}$ | [95% PI] | NNT[a] [95% CI] | Effect size$_{adj}$ [95% CI] | K$_{imp}$ |
|---|---|---|---|---|---|---|---|---|
| **Gambling severity** | | **Hedges' g** | | | | | **Hedges' g$_{adj}$** | |
| *All comparisons* | 28 | −0.71 [−1.03; −0.39] | <0.0001 | 89.6 | [−2.34; 0.92] | 2.6 [1.9, 4.6] | – | – |
| PFI control conditions excluded | 28 | −0.72 [−1.03; −0.40] | <0.0001 | 90.3 | [−2.32; 0.89] | 2.6 [1.9; 4.5] | – | – |
| Outliers excluded[b] | 26 | −0.59 [−0.87; −0.30] | **0.0001** | 86.8 | [−1.97; 0.80] | 3.1 [2.2; 5.9] | – | – |
| *Modality* | | | | | | | | |
| CBT | 18 | −0.85 [−1.36; −0.34] | **0.0012** | 94.5 | [−3.11; 1.41] | 2.2 [1.5; 5.3] | – | – |
| MI | 3 | 0.08 [−0.15; 0.32] | 0.4850 | 0.0 | [−1.44; 1.61] | – | – | – |
| CBT/MI | 7 | −0.53 [−0.94; −0.12] | **0.0108** | 78.2 | [−1.88; 0.82] | 3.4 [2.0; 14.5] | – | – |
| Other interventions | 5 | −0.78 [−1.03; −0.52] | <0.0001 | 0.0 | [−1.18; −0.37] | 2.4 [1.9; 3.5] | – | – |
| *Mode of delivery and format* | | | | | | | | |
| Face-to-face | 16 | −1.03 [−1.54; −0.53] | **0.0001** | 87.8 | [−3.08; 1.01] | 1.9 [1.4; 3.4] | – | – |
| Individually | 10 | −0.89 [−1.53; −0.25] | **0.0062** | 91.1 | [−3.25; 1.46] | 2.1 [1.4; 7.0] | – | – |
| In groups | 6 | −1.33 [−2.18; −0.47] | **0.0023** | 74.4 | [−4.01; 1.35] | 1.5 [1.1; 3.8] | −0.86 [−1.74; 0.02] | 2 |
| Remote | 13 | −0.36 [−0.65; −0.06] | **0.0184** | 84.7 | [−1.47; 0.76] | 5.0 [2.8; 29.6] | – | – |
| Therapist guided | 6 | −0.42 [−0.97; 0.14] | 0.1421 | 83.3 | [−2.33; 1.49] | – | – | – |
| Unguided | 8 | −0.22 [−0.55; 0.12] | 0.2057 | 85.4 | [−1.37; 0.93] | – | – | – |
| Internet program | 6 | −0.42 [−0.92; 0.09] | 0.1080 | 91.2 | [−2.23; 1.40] | – | – | – |
| **Remission** | | **Odds Ratio** | | | | | **Odds Ratio$_{adj}$** | |
| *All comparisons* | 12 | 0.47 [0.25; 0.88] | **0.0178** | 80.3 | [0.05; 4.27] | 5.3 [3.0; 32.4] | – | – |
| Outliers excluded[b] | 11 | 0.56 [0.32; 0.97] | **0.0376** | 74.1 | [0.09; 3.47] | 7.1 [3.6; 129.5] | – | – |
| *Modality* | | | | | | | | |
| CBT | 9 | 0.45 [0.19; 1.04] | 0.0616 | 81.6 | [0.03; 6.97] | – | – | – |
| *Mode of delivery and format* | | | | | | | | |
| Face-to-face | 7 | 0.24 [0.08; 0.73] | **0.0116** | 78.9 | [0.01; 8.63] | 2.9 [1.9; 13.1] | – | – |
| Individually | 3 | 0.54 [0.27; 1.09] | 0.0845 | 34.3 | [0.00; 346.26] | – | – | – |
| In groups | 4 | 0.10 [0.02; 0.61] | **0.0128** | 73.0 | [0.00; 234.95] | 2.0 [1.6; 8.5] | – | – |
| Remote | 6 | 0.87 [0.63; 1.20] | 0.3850 | 17.3 | [0.45; 1.67] | – | 0.94 [0.65; 1.37] | 1 |
| Therapist guided | 3 | 0.82 [0.38; 1.76] | 0.6019 | 64.0 | [0.00; 3,838.27] | – | – | – |
| Unguided | 3 | 0.80 [0.52; 1.22] | 0.2906 | 0.0 | [0.05; 12.38] | – | – | – |
| **Depressive symptoms** | | **Hedges' g** | | | | | **Hedges' g$_{adj}$** | |
| *All comparisons* | 8 | −0.46 [−0.77; −0.15] | **0.0034** | 55.4 | [−1.34; 0.42] | 3.9 [2.4; 11.7] | – | – |
| *Modality* | | | | | | | | |
| CBT | 6 | −0.40 [−0.74; −0.06] | **0.0200** | 48.4 | [−1.33; 0.53] | 4.5 [2.5; 28.1] | – | – |
| *Mode of delivery* | | | | | | | | |
| Face-to-face | 4 | −0.63 [−0.97; −0.30] | **0.0002** | 0.0 | [−1.37; 0.10] | 2.9 [2.0; 6.0] | – | – |
| Remote | 4 | −0.32 [−0.77; 0.12] | 0.1509 | 68.6 | [−2.2; 1.55] | – | – | – |
| **Anxiety** | | **Hedges' g** | | | | | **Hedges' g$_{adj}$** | |
| *All comparisons* | 7 | −0.56 [−0.78; −0.35] | <0.0000 | 0.0 | [−0.85; −0.28] | 3.2 [2.4; 5.2] | −0.54 [−0.75; −0.33] | 1 |
| *Modality* | | | | | | | | |
| CBT | 5 | −0.60 [−0.86; −0.35] | <0.0000 | 0.0 | [−1.02; −0.19] | 3.0 [2.2; 5.1] | – | – |
| *Mode of delivery* | | | | | | | | |
| Face-to-face | 4 | −0.68 [−1.02; −0.35] | **0.0001** | 0.0 | [−1.42; 0.06] | 2.7 [1.9; 5.2] | – | – |
| Remote | 3 | −0.48 [−0.77; −0.20] | **0.0010** | 0.0 | [−2.33; 1.37] | 3.8 [2.4; 9.1] | −0.34 [−0.56; −0.11] | 2 |

Bold *p*-values are statistically significant (<0.05), abbreviations: K, number of comparisons; CBT, cognitive behavioral therapy; MI, motivational intervention; PI, prediction interval; Effect size$_{adj}$, Effect size adjusted for publication bias, K$_{imp}$, number of studies imputed to adjust for publication bias using trim and fill; NNT, number-needed-to-treat, *) for estimates generated on only few comparisons, heterogeneity and random variance is not possible to outline, leading to large confidence intervals on tau$^2$. Thus, $I^2$ becomes biased towards homogeneity ($I^2 = 0$) (Higgins & Thompson, 2002), a) NNT was calculated only for estimates of effect that were statistically significant, b) in sensitivity analysis studies identified as 2 standard deviations above/below the pooled estimate were excluded.
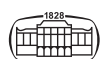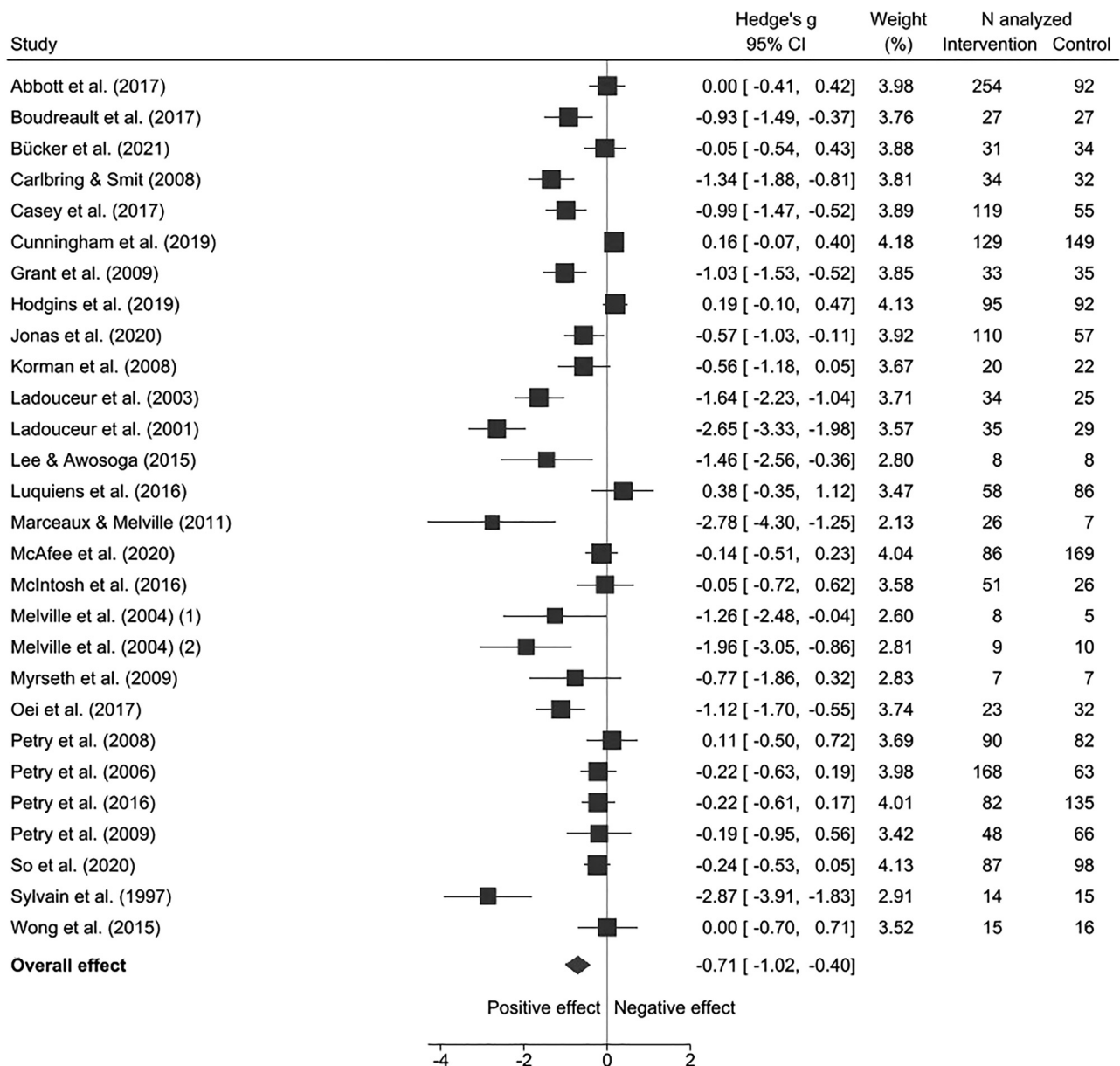
*Fig. 2.* Efficacy of psychological intervention overall
Forest plot displaying the efficacy of psychological intervention at the end of treatment as measured by gambling disorder symptom severity across 28 studies. See Supplementary Material 1 Figs S2 – S30 for forest plots on remaining outcomes

These results are presented in Supplementary Material 1 Table S4. A small amount of data was available for analysis on long term efficacy (follow-up). Effect sizes were generally small and/or not significant (Supplementary Material 1 Table S5 and S6).

## Moderators

Regression-based moderator analyses were possible for a number of variables, mainly for gambling severity. See Table 3 and description below.

The meta-regression analysis comparing treatment modalities (CBT, MI, CBT combined with MI, and "other") did not reveal any significant moderation. Compared with remotely delivered interventions, face-to-face delivered interventions were more efficacious with respect to both severity and remission. Among face-to-face interventions, the format (individual *vs* group) did not moderate the efficacy. Neither did therapist contact (therapist-guided *vs* unguided) for remote interventions. The number of sessions with a therapist positively predicted the treatment effect when including all studies and face-to-face interventions

*Table 3.* Meta-regression based moderator analyses

| Outcome variable | Moderator variable | K[a] | Slope | 95% CI | *p* value |
|---|---|---|---|---|---|
| **All interventions** | | | | | |
| *Gambling severity* | Modality – CBT vs. MI/CBT | 18/7 | 0.27 | [−0.48; 1.01] | 0.4830 |
| | CBT vs. Other | 5 | −0.14 | [−1.02; 0.74] | 0.7565 |
| | CBT vs. MI | 3 | 0.85 | [−0.18; 1.88] | 0.1048 |
| | Mode of delivery – face-to-face vs. remote | 16/13 | 0.64 | [0.06; 1.23] | **0.0306** |
| | Type of control group – passive vs. active | 19/13 | 0.73 | [0.21; 1.25] | **0.0063** |
| | GD as eligibility criterion – yes vs. no | 14/14 | 1.05 | [0.56; 1.55] | **<0.0001** |
| | Comorbidity excluded – no vs. yes | 11/17 | <0.01 | [−0.67; 0.68] | 0.9939 |
| | Therapist fidelity assessment – no vs. yes | 9/14 | 0.15 | [−0.62; 0.91] | 0.7110 |
| | Proportion[b] with GD | 26 | −0.16 | [−0.28; −0.04] | **0.0116** |
| | Proportion[b] female | 28 | 0.00 | [−0.17; 0.16] | 0.9562 |
| | Proportion[b] married | 13 | −0.13 | [−0.28; 0.01] | 0.0669 |
| | Sample mean age | 27 | −0.04 | [−0.08; 0.00] | 0.0610 |
| | No. of contact sessions[c] | 25 | −0.05 | [−0.09; −0.01] | **0.0156** |
| | Length of treatment period[d] | 27 | −0.09 | [−0.15; −0.03] | **0.0053** |
| | Date of publication (years until 2021) | 28 | 0.09 | [0.05; 0.12] | **<0.0001** |
| *Remission* | Mode of delivery – face-to-face vs. remote | 7/6 | 1.07 | [0.03; 2.10] | **0.0446** |
| | Type of control group – passive vs. active | 7/6 | 0.70 | [−0.53; 1.92] | 0.2655 |
| | GD as eligibility criterion – yes vs. no | 5/7 | 1.56 | [0.50; 2.61] | **0.0039** |
| | Comorbidity excluded – no vs. yes | 5/7 | 0.38 | [−0.99; 1.74] | 0.5902 |
| | Therapist fidelity assessment – no vs. yes | 3/7 | 0.72 | [−1.31; 2.75] | 0.4859 |
| | Proportion[b] with GD | 12 | −0.14 | [−0.40; 0.13] | 0.3246 |
| | Proportion[b] female | 12 | −0.06 | [−0.49; 0.37] | 0.7848 |
| | Sample mean age | 11 | −0.07 | [−0.15; 0.00] | 0.0634 |
| | No. of contact sessions[c] | 11 | −0.02 | [−0.11; 0.08] | 0.7470 |
| | Length of treatment period[d] | 12 | −0.08 | [−0.23; 0.07] | 0.3075 |
| | Date of publication (years until 2021) | 12 | 0.12 | [0.03; 0.20] | **0.0065** |
| **Face-to-face intervention** | | | | | |
| *Gambling severity* | Format – individual vs. group | 10/6 | −0.45 | [−1.55; 0.66] | 0.4272 |
| | Type of control group – passive vs. active | 11/7 | 1.03 | [0.23; 1.84] | **0.0116** |
| | GD as eligibility criterion – yes vs. no | 11/5 | 1.42 | [0.63; 2.21] | **<0.0001** |
| | Comorbidity excluded – no vs. yes | 5/11 | 1.13 | [0.05; 2.22] | **0.0408** |
| | Therapist fidelity assessment – no vs. yes | 4/12 | 0.76 | [−0.42; 1.95] | 0.2078 |
| | Proportion[b] with GD | 15 | −0.39 | [−0.77; −0.02] | **0.0386** |
| | Proportion[b] female | 16 | −0.08 | [−0.32; 0.17] | 0.5489 |
| | Sample mean age | 15 | −0.04 | [−0.11; 0.03] | 0.2659 |
| | No. of contact sessions[b] | 15 | −0.10 | [−0.16; −0.05] | **0.0004** |
| | Length of treatment period[c] | 15 | −0.09 | [−0.17; −0.01] | **0.0234** |
| | Date of publication (years before 2021) | 16 | 0.12 | [0.05; 0.19] | **0.0004** |
| **Remote intervention** | | | | | |
| *Gambling severity* | Therapist guidance – guided vs. unguided | 6/8 | 0.22 | [−0.38; 0.82] | 0.4703 |
| | Type of control group – passive vs. active | 9/6 | 0.36 | [−0.16; 0.88] | 0.1765 |
| | GD as eligibility criterion – yes vs. no | 4/9 | 0.27 | [−0.39; 0.92] | 0.4254 |
| | Comorbidity excluded – no vs. yes | 6/7 | −0.48 | [−1.03; 0.06] | 0.0801 |
| | Proportion[b] with GD | 12 | −0.07 | [−0.16; 0.03] | 0.1628 |
| | Proportion[b] female | 13 | 0.04 | [−0.15; 0.23] | 0.6930 |
| | Sample mean age | 13 | −0.01 | [−0.05; 0.02] | 0.4667 |
| | Length of treatment period[c] | 13 | −0.03 | [−0.13; 0.08] | 0.6275 |
| | Date of publication (years until 2021) | 13 | 0.03 | [−0.04; 0.10] | 0.3758 |

Bold *p*-values indicate statistical significance (<0.05); β, slope of the regression; CBT, cognitive behavioral therapy; CI, confidence interval; GD, gambling disorder; K, number of parameters in the analysis; MI, motivational intervention; SE, standard error, a) for dichotomous variables: contrast/comparator, b) the correlation coefficient corresponds to a 10% change in this variable, c) if a study had multiple intervention groups with different number of contact sessions, the minimum value was used in the regression, d) if a study had multiple intervention groups with different length of treatment, the minimum value was used in the regression.

only, and the length of the intended treatment period positively predicted the treatment effect across all interventions and face-to-face interventions.

Overall, studies with a GD eligibility criterion displayed larger effects on both primary outcomes than studies allowing individuals with subclinical levels of GD to participate. A similar association was seen for face-to-face interventions. Likewise, the proportion of the samples meeting the criteria for GD at baseline predicted the treatment effects both when including all studies and when including only face-to-face interventions.

The type of control group affected the efficacy of the intervention on gambling severity, when including all interventions and face-to-face interventions. Studies with passive controls showed larger effects. For both primary outcomes, publication date (years before 2021) positively predicted treatment efficacy across all interventions and across face-to-face interventions. Older studies display larger effects.

## Secondary outcomes

While supported by few data the analysis of the secondary outcomes of depressive symptoms and anxiety consistently indicated that psychological intervention for GD benefits mental health in general (Table 2).

## Risk of bias and quality of evidence

Overall, RoB 2 study ratings indicated a high risk of bias, though with less risk of bias in more recently published studies and studies of remote intervention (Supplementary Material 1 Table S7 and Fig. S1). In a majority (73%) of studies RoB 2 domain four (measurement of the outcome) was evaluated as high risk, mostly explained by difficulties in blinding self-reporters from the allocated treatment or control condition and the fact that most outcomes were based on self-report. The overall quality of evidence of the meta-analytic results was rated as low to very low dependent on the outcome assessed with the GRADE system, primarily due to the general high risk of bias and between-study inconsistency in effect sizes, and in some instances due to few data on a given outcome (see Supplementary Material 1 Table S8 to S11).

## DISCUSSION

Since the most recent meta-analysis published in 2017 (Goslar et al., 2017), several RCTs exploring psychological intervention for GD have been published, of which 12 were included in the present meta-analysis, and with remote interventions represented in 10 studies. This enabled us to comprehensively explore the efficacy of psychological interventions for GD across modality, mode of delivery, and format in currently available RCTs. To our knowledge, the present review and meta-analysis is the first study to employ this broad scope while considering only RCTs to maximize the quality of the evidence.

Overall, psychological interventions were efficacious in treating GD. Pooling data across the 30 included RCTs, we found reductions in GD symptom severity of medium effect size, remission in favor of intervention groups, and positive effects on depressive symptoms and anxiety post-treatment. These findings reflect a heterogeneous sample of interventions among which only few treatment protocols have been tested more than once, and as other researchers have noticed (Cowlishaw et al., 2012) there is still no "gold standard" against which to compare alternative interventions.

Confirming what has been observed in previous meta-analyses (Cowlishaw et al., 2012; Goslar et al., 2017; Pfund et al., 2020), we found that across modalities, CBT was associated with the largest effect sizes followed by CBT combined with MI. CBT is by far the most studied modality, and alternative modalities (e.g., contemporary CBT such as dialectical behavior therapy and mindfulness-based approaches) have only been explored to a limited extent. While CBT displays promising results, an important next step may be focusing on identifying which psychological treatment modality works best for whom (Dowling et al., 2016; Petry et al., 2005; Pfund et al., 2021). To further evaluate this issue, we explored the possible influence of a number of patient sample characteristics on treatment efficacy, including mean age, proportion married, and proportion female, none of which revealed any robust associations (Table 3). The lack of moderating effect of gender may be particularly conclusive in that approximately 40% of patients across studies were female, a seemingly large proportion compared to the gender distributions typically reported for samples of treatment seeking gamblers (Potenza et al., 2019). As a way of approaching the topic of GD patient subtypes, we also intended to explore possible associations between patients' preferred type of gambling and treatment efficacy. However, due to large variations in how studies reported data on gambling types, we were unable to conduct the intended analyses. Both theory and research indicate that GD manifests itself heterogeneously across patients and several between-patient differences have been suggested, e.g., according to symptom severity, gambling patterns, preferred type of gambling, and personality variables (Excell et al., 2022). An important task of future research will be to establish a therapeutically informative typology. A relevant theoretical framework in this regard is the Pathways Model which categorized GD patients according to their etiology and their motives for gambling, resulting in three specific subtypes: conditioned, emotionally vulnerable, and impulsive/antisocial gamblers (Blaszczynski & Nower, 2002; Nower et al., 2021). Differing in their motives for gambling, patients may present differing therapeutic challenges. Thus different therapeutic methods and mechanisms may facilitate changes to symptoms and behavior in these subgroups of patients. While subtyping gamblers is still an ongoing discussion, exploring treatment response by patient subgroup could provide further insights to the efficacy of different treatment modalities exceeding that of universal "one size fits all" conclusions (Dowling et al., 2016).

Elaborating on heterogeneity, psychiatric comorbidity is very common among GD patients. In our analysis, we found no difference in intervention efficacy between studies that explicitly excluded patients with psychiatric comorbidity and studies that did not. While having received increased attention in recent years, still much research is needed as to how specific comorbid psychiatric conditions may influence patient receptivity to psychological intervention for GD (Dowling et al., 2015). Left untreated, conditions such as ADHD or severe depression that are associated with executive dysfunction (Silverstein et al., 2020; Warren, Heller, & Miller, 2021), and often times require medical attention (Boland et al., 2020), may hinder positive treatment outcomes. This accentuates the relevance of approaching people with GD as a heterogeneous group of patients, that require careful psychiatric assessment and proper interdisciplinary and/or personalized care. Consistently assessing and reporting on subgroups and psychiatric comorbidities within RCT patient groups may be a starting point.

Even though we did cover several recently published studies on remote intervention and found a treatment effect for this category, our results are remarkably similar to those of Goslar et al. (2017) when comparing remote intervention to face-to-face intervention on the outcome of GD symptom severity. Face-to-face intervention produce larger effects. Offering efficacious remote treatment for GD, however, may circumvent practical as well as psychological barriers associated with face-to-face intervention (e.g., monetary costs, distance, lack of flexibility, secrecy, embarrassment, fear of stigma) (Clarke, Abbott, DeSouza, & Bellringer, 2007; Rockloff & Schofield, 2004; Suurvali, Cordingley, Hodgins, & Cunningham, 2009). Considering that remote intervention has displayed efficacy comparable to that of face-to-face intervention for other psychiatric disorders (e.g., depression and anxiety) (Carlbring, Andersson, Cuijpers, Riper, & Hedman-Lagerlöf, 2018), there may be room for improvement. Our moderator analyses revealed that the proportion of samples meeting the criteria for GD at baseline positively predict the magnitude of the treatment effect. This may reflect a floor effect, since less severely affected patients can improve less. In studies of remote interventions, the proportion of patients meeting the criteria for GD was generally lower (see Table 1). As such, the difference in treatment efficacy observed between face-to-face and remote interventions may be partly due to such floor effect. Including more patients with GD in future studies of remote intervention may thus lead to an increase in intervention effects obtained. Another issue may be the quality of treatment courses and content. As of right now, the category of remote intervention for GD is highly heterogeneous (e.g., books, PDFs, internet-programs with or without therapist guidance), and may differ on key factors of attrition and/or treatment effects (e.g., user-friendliness, intensity, content quality). Internet-based interventions pave the way for dynamic and interactive features and may serve as a platform with easily applicable therapist-patient correspondence (Sagoe et al., 2021), whereas bibliotherapies are more restricted in this regard. We did not find either length of

treatment or therapist guidance to moderate the efficacy of remote intervention but these findings should be interpreted with caution because of the few studies included and the variety among interventions covered. Yet, regardless of content and quality, GD as compared to other common mental health problems (e.g. anxiety and depression) may be inherently difficult to treat remotely, without therapist support at least, because a large proportion of patients trying to remain abstinent from gambling experience irritability and/or restlessness (APA, 2013) and urges to gamble. Hence the decision not to adhere to a remote non-therapist-assisted treatment program may be compelling and less easily resisted from.

## Limitations to the field and future perspectives

There are a number of limitations to this field of research in general. Importantly, there is a lack of reliable data on long-term effects. Since GD has a chronic nature with a considerable risk of relapse (Potenza et al., 2019), knowledge on long-term efficacy of treatment is central. Employing active control groups in future studies may be key to ascertain whether long-term treatment effects do exist. Furthermore, identifying treatment effects above those of active control conditions will strengthen the confidence that interventions are efficient. We suggest considering PFI an easily applicable standardized frame of reference for active treatments to compare against, since this very brief intervention has produced treatment effects above that of passive control groups (Peter et al., 2019).

The reliability of the results on face-to-face intervention may be limited. With no publications identified since 2016 (McIntosh, Crino, & O'Neill, 2016; Petry, Rash, & Alessi, 2016), and our ratings suggesting that these studies carry a great risk of bias, some of the studies of face-to-face intervention may be outdated. Our meta-regression analyses show that older studies are associated with larger effects. Generally, domain four (measurement of the outcome) was rated high risk in a majority of the included studies. The difficulty of blinding patients to condition and the risks of bias associated with self-report, though, reflect two common issues in trials of clinical psychological intervention, that are not unique to the domain of GD (Boot, Simons, Stothart, & Stutts, 2013). Nonetheless, going forward, it is important to replicate earlier findings on face-to-face interventions through rigorous methodological designs and data analysis of contemporary standard.

GD often co-occurs with other mental disorders, distress, or social difficulties (Potenza et al., 2019). Due to the few studies ($n = 8$) reporting on depressive symptoms and anxiety, we were able to explore the efficacy of psychological intervention for GD on general mental health only to a limited extent. Future research may benefit from assessing and reporting on the general mental health and social functioning of GD patients. Overcoming GD is not equal to having acquired a stable mental health, and GD is known to negatively impact social relations (American Psychiatric Association, 2013). Exploring the integration of concerned

significant others and/or family-oriented intervention may be relevant in this regard. Research on other addictive disorders show promising results by the integration of concerned significant others (Ariss & Fairbairn, 2020; McCrady & Flanagan, 2021; Powers, Vedel, & Emmelkamp, 2008), while GD research is sparse on this particular topic (Merkouris, Rodda, & Dowling, 2022).

## Study strengths and limitations

The present review has several strengths. Covering six scientific databases, we conducted a thorough literature search including backwards and forwards snowballing with all steps from selecting and rating studies to extracting and coding data done by at least two reviewers independently. Only RCTs were accepted, and outcomes were considered only when based on validated instruments. To ensure as much data as possible on our primary outcomes, several researchers were contacted to obtain data that was not reported in published reports. This comprehensive coverage of studies and data enabled us to conduct several relevant moderator- and meta-regression-analyses to an extent not formerly accomplished.

There are some limitations to our study as well. Not including outcomes such as gambling frequency and expenditure may have increased the risk of excluding RCTs that did not report on gambling symptom severity and/or remission, but may have provided relevant information on treatment efficacy. This will be of relevance in future updates of the present study. Also, additional data may exist among non-published data, non-English reports, and grey literature, although generally, our analyses indicate that publication bias did not characterize our study sample (see funnel plots in Supplementary Material 1 Figs S31-S60). Sensitivity analyses on the other hand revealed that our overall estimate of efficacy was noticeably affected by two identified outliers within our study sample (Marceaux & Melville, 2011; Sylvain, Ladouceur, & Boisvert, 1997) (see Table 2), both covering face-to-face intervention and showing very large treatment effects. This accentuates the importance of replicating early studies of face-to-face intervention, and it may suggest that the difference in efficacy between face-to-face and remotely delivered intervention observed in the present meta-analysis is in fact less pronounced. Lastly, our subgroup and moderator analyses could have been more robust if we had requested study authors for data on other variables (e.g., patient and intervention characteristics) than our primary outcomes. In perspective of the hitherto fairly modest number of RCTs published within the field, this may be an important objective for future updates of the present review in order to more robustly explore sources of heterogeneity.

## CONCLUSION

Having covered 30 RCTs in our meta-analysis, and bearing in mind the aforementioned limitations, a number of conclusions can be drawn.

On a general level across modalities, formats, and modes of delivery, psychological intervention appears to be efficacious in treating GD, short term at least. Knowledge on long-term efficacy remains limited. We suggest using PFI as an easily applicable standardized frame of reference for psychological interventions to compare against when studying long term effects, since PFI has shown treatment efficacy above that of passive control groups.

Among therapeutic modalities, CBT is associated with the largest effect sizes. Nonetheless, other modalities, even the most popular (e.g. MI), are far less studied, and much has yet to be explored. Doing so while concurrently exploring treatment response among subtypes of GD patients will further our knowledge in a manner that is highly clinically relevant.

Lastly, we observed a difference in treatment efficacy favoring face-to-face interventions over remotely delivered interventions. We suggest that further development of digital psychological intervention along with the replication of early studies on face-to-face psychological intervention may in fact lessen the gap that currently available data conveys.

her valuable contribution during the development of the search strategy employed for the present study.

## SUPPLEMENTARY MATERIAL

Supplementary data to this article can be found online at https://doi.org/10.1556/2006.2023.00034.

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